

COPPER COMPOUNDS

CAS Registry Number: 7440-50-8

Cu

Molecular Formula: Cu

Copper is reddish in color and is a ductile, malleable metal. It is extracted from ores and is available as ingots, sheets, wire or powder (Merck, 1989). Atmospheric corrosion of copper occurs in moist air forming a layer of hydrated basic carbonate. It is an excellent conductor of electricity and it dissolves in nitric, sulfuric, and hydrochloric acids and is readily attacked by alkalies. Liquid copper explodes on contact with water and powder and is combustible (Sax, 1987; Sax, 1989).

Examples of Copper Compounds

Copper acetate	Copper hydride
Copper (II) acetate monohydrate	Copper hydroxide
Copper (II)acetylde	Copper (II) nitrate
Copper alloy	Copper (I) nitride
Copper arsenate hydroxide	Copper 1,3,5-octatrien-7-ynide
Copper ascorbate	Copper orthoarsenate
Copper azide	Copper (I) oxalate
Copper (II) carbonate hydroxide	Copper oxide
Copper (I) and (II) chloride	Copper perchlorate
Copper (I) chloroacetylde	Copper phosphinate
Copper chromate	Copper sorbate
Copper(I) citrate	Copper sulfate
Copper cyanide	Copper sulfide
Copper (II)-1,3-di(5-trazoly)	Copper tetrahydroaluminate
Copper dimethyldithiocarbamate	Copper traizenide
Copper EDTA complex	Copper 2,4,5-trichlorophenolate
Copper fume	Copper zinc alloys

Physical Properties of Copper

Synonyms: allbri natural copper; ANAC 110; Arwood copper; CDA 101, 102, 110, 122; copper-milled

Atomic Weight:	63.54
Atomic Number:	29
Valence Number:	1,2
Boiling Point:	2,324 °C
Melting Point:	1,083 °C
Density:	8.92
Vapor Pressure:	1 mm at 1,628 °C

(Merck, 1989; Sax, 1989)

SOURCES AND EMISSIONS

A. Sources

Copper is used in electrical wiring, switches, plumbing, heating, roofing and building construction, chemical and pharmaceutical machinery, electroplated coatings, piping, insecticides, catalysts, and in anti-fouling paints (Sax, 1987). It is also used in carbides and high speed steels (HSDB, 1991).

Copper compounds are registered as algacides, molluscicides, and as antifoulants. Copper chloride (basic) is registered as a fungicide and is used on a variety of fruit, vegetable, and ornamental plants for the prevention of fungal and bacterial diseases. Metallic copper is registered for use in antifoulant paints for application to ships and boats, for the control of barnacles and other aquatic organisms. Copper sulfate (basic, anhydrous, and pentahydrate) is registered as a fungicide and is used on a variety of fruit, vegetable, and ornamental plants for the prevention of fungal and bacterial diseases (DPR, 1996).

The licensing and regulation of pesticides for sale and use in California is the responsibility of the Department of Pesticide Regulation (DPR). Information presented in this fact sheet regarding the permitted pesticidal uses of copper chloride, metallic copper, and copper sulfate has been collected from pesticide labels registered for use in California and from DPR's pesticide databases. This information reflects pesticide use and permitted uses in California as of October 15, 1996. For further information regarding the pesticidal use of these compounds, please contact the Pesticide Registration Branch of DPR (DPR, 1996).

The primary stationary sources that have reported emissions of copper compounds in California are manufacturers of ships and boats, manufacture of electrical lighting and wiring equipment, and electrical services (ARB, 1997b).

Copper has also been identified but not quantified in motor vehicle exhaust by the Air Resources Board (ARB) (ARB, 1991e).

B. Emissions

The total emissions of copper compounds from stationary sources in California are estimated to be at least 82,000 pounds per year, based on data reported under the Air Toxics “Hot Spots” Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Copper is found in its native state in the earth's crust at 70 parts per million (ppm) and in seawater at 0.001 to 0.02 ppm. It is also found in the following ores: azurite; azurmalachite; chalcocite; chalcopyrite (copper pyrites) covellite; and cuprite malachite (Merck, 1989). Copper is found in sulfides, arsenites, chlorides, and carbonates with the highest concentrations in the ferromagnesium minerals, such as the basalts, pyropene and biotite, where it averages 140 ppm. Sandstones contain 10 to 40 ppm, shales contain 30 to 150 ppm, and marine black shales contain 20 to 300 ppm of copper. Copper can also be found concentrated in clay mineral fractions containing much organic carbon (HSDB, 1993).

AMBIENT CONCENTRATIONS

Copper and its species are routinely monitored by the statewide ARB air toxics network. The network's mean concentration of copper from January 1996 through December 1996 is estimated to be 34.9 nanograms per cubic meter (ng/m³) (ARB, 1997c). Ambient air concentrations of copper in the United States have also been reported to vary from 10 to 570 ng/m³, the highest values being found in urban areas (HSDB, 1991).

INDOOR SOURCES AND CONCENTRATIONS

Major sources of indoor airborne copper identified by source apportionment methods include infiltration of outdoor air, smoking, cooking, and other indoor sources (Ozkaynak et al., 1996). The “other” indoor sources were unidentified, but may have included activities such as cleaning, dusting, vacuuming, and hobbies. A New York study of 178 single-family suburban homes identified kerosene heaters (and possibly electric motors in vacuum cleaners and fans) as a significant source of indoor copper (Koutrakis et al., 1992).

Copper was measured in about 170 homes during the fall of 1990 in southern California. Indoor PM₁₀ (particles less than 10 microns in diameter) concentrations of copper ranged approximately from 7 to 100 ng/m³ with an average of 23 ng/m³ during the daytime, and from 4 to 71 ng/m³ with an average of 16 ng/m³ during the nighttime. Outdoor copper concentrations ranged from 7 to 35 ng/m³ with an average of 16 ng/m³ during the daytime, and from 4 to

71 ng/m³ with an average of 18 ng/m³ during the nighttime (Pellizzari et al., 1992).

Copper concentrations (PM₁₀) measured by personal exposure samplers during the daytime were much greater than the concentrations measured indoors or outdoors at these homes. Personal exposure to copper concentrations ranged from 15 to 180 ng/m³ with an average of 43 ng/m³ during the daytime, and from 6 to 76 ng/m³ with an average of 20 ng/m³ during the nighttime (Pellizzari et al., 1992).

ATMOSPHERIC PERSISTENCE

Copper compounds are expected to be particle-associated in the atmosphere, and hence subject to wet and dry deposition. The average half-life and lifetime for particles and particle-associated chemicals in the atmosphere is estimated to be about 3.5 to 10 days and 5 to 15 days, respectively (Balkanski et al., 1993; Atkinson, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer effects, copper and its compounds contributed to the total hazard index in 33 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1, and presented an individual hazard index greater than 1 in 1 of these risk assessments. Copper and its compounds also contributed to the total hazard index in 39 of the approximately 107 risk assessments reporting a total acute hazard index greater than 1, and presented an individual hazard index greater than 1 in 9 of these risk assessments (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to copper and its compounds are inhalation, ingestion, and dermal contact. The primary forms are metallic copper, copper oxide, and copper sulfate.

Non-Cancer: Copper is an essential nutrient which is necessary for metabolism and the production of certain macromolecules including hemoglobin. Fumes and dust of copper compounds may cause irritation of the upper respiratory tract or nasal and pharyngeal congestion (HSDB, 1995). Inhalation of fumes from the heating of metallic copper (forming copper oxide) or copper dust can result in an acute condition known as “metal fume fever” with symptoms of headache, chills, fever, and muscle aches. Other symptoms sometimes associated with exposure to copper fumes include gastric pain and nausea. Cases of copper poisoning, primarily from ingestion of copper sulfate, have shown exposure to high levels results in kidney damage. Hereditary Wilson’s disease results in excessive retention of copper in the body and leads to liver and kidney damage and anemia (Sittig, 1991). Skin irritation and eczema can result from skin

exposure (HSDB, 1995).

An acute non-cancer Reference Exposure Level (REL) of 10 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) and a chronic non-cancer REL of $2.4 \mu\text{g}/\text{m}^3$ are listed for copper compounds in the California Air Pollution Control Officers Association Air Toxics “Hot Spots” Program, Revised 1992 Risk Assessment Guidelines. Both RELs are based on respiratory effects (CAPCOA, 1993). The United States Environmental Protection Agency (U.S. EPA) has not established a Reference Concentration (RfC) for copper compounds (U.S. EPA, 1994a).

No information is available on developmental or reproductive effects in humans or in animals by inhalation exposure. By injection, copper citrate produces heart malformations in hamsters. High levels of copper in the diet of mink led to increased postnatal mortality (ATSDR, 1990a).

Cancer: The U.S. EPA has classified copper in Group D: Not classifiable due to inadequate evidence as to its carcinogenic potential (U.S. EPA, 1995a). The International Agency for Research on Cancer has classified copper in Group 3: Not classifiable due to inadequate evidence as to its carcinogenic potential (IARC, 1987a).

